satellites, an argument might be derived from the fact for the smallness of the mass of the ring, — since, for bodies so near to it, its attraction will differ considerably from what it would be were all its mass collected in the centre.

"The method employed by Bessel, in which the mass is derived from the motion of the line of apsides (a constantly accumulating quantity), is a better one."

Professor Peirce made further remarks upon the same subject.

Dr. B. A. Gould, Jr. exhibited to the Academy an admirable model, to represent the orbits of the sixteen asteroids, which was recently made by Chamberlain and Ritchie for the Lowell Institute, under his directions.

Three hundred and sixtieth meeting.

April 6, 1852. — MONTHLY MEETING.

The PRESIDENT in the chair.

On motion of Mr. J. I. Bowditch, who stated that the Librarian was sick, it was

Voted, That the charge of removing the Academy's books to their new room in the Athenæum be transferred to the Committee on the Library.

Dr. J. C. Warren gave an account of his visit to Darmstadt, in the year 1851, to see the Eppelsheim fossils, and exhibited a considerable number of casts of fossil bones of the Dinotherium giganteum, together with an excellent colored drawing, of the natural size, of the head.

"Having become much interested in the Eppelsheim fossils, I took the opportunity while in Europe in 1851 to visit Darmstadt, where this collection is, and its able and excellent Professor, M. Kaup.

"Darmstadt, the capital of the Grand Duchy of Hesse, is situated at a short distance from the Rhine, and near to Frankfort. The town contains about eight thousand inhabitants. It is built of stone, with wide streets, has many public ornaments, and is surrounded by gardens and groves, which extend in some directions for miles, and contribute to make it a desirable residence.

"The collection is placed in the Castle, so called, and is rich in

objects of natural history. Professor Kaup, as soon as I called on him, conducted me to the Castle, and, having exposed to view the objects of my research, left me to examine them as long as I thought proper.

"My attention was first directed to the Mastodon relics. Professor Kaup had instituted a new species of Mastodon, under the name of M. longirostris, thus separating it from M. angustidens, with which it had formerly been confounded. The name *longirostris* is derived from the length of its jaw compared with that of other Mastodons. Another distinction is in the form of its teeth, the number of eminences on most of them being greater than in other animals of the same family. The number of teeth is also greater than in the M. giganteus, the latter having twenty-four teeth, to which are added in the former two germs in the upper, and possibly two in the lower jaw; which last, however, I believe, have not been ascertained. A very fine collection of teeth, both in and out of place, serves to illustrate some of the most important points of Mastodon odontology.

"From the examination of these valuable fossils, my attention was next attracted to one of the most remarkable relics of the ancient world, the Dinotherium. This is thought to have been the largest of terrestrial quadrupeds. The first remains of this animal were found in France during the last century. Fragments of skeletons continued to be discovered during the early period of the present, when, in 1829, Professor Kaup obtained from the Eppelsheim deposit a sufficient number of bones to satisfy him that this was a new genus, to which he gave the name Dinotherium, from δεινός, *terrible*, and θηρίον, *animal.*

"Before this time, it had been thought by some writers to belong to a marine family, such as the Manatus or the Dugong, from the form of the occipital condyle; by others to the Pangolin, a kind of hedgehog, from an ungual phalanx, now considered to have been the relic of some other animal. And by Cuvier it was thought to be allied to the Tapir, from the form of its pre-molar teeth; the outer ridges of which are united by a connecting wall, as in the corresponding teeth of the Tapir.

"A remarkable instance is afforded by the last circumstance of the sagacity and science of this celebrated person, who, from so small a piece of mechanism, could imagine the whole structure and habits of the animal. Professors De Blainville and Kaup have justly remarked, however, that the pretension of being able to construct a skeleton from a single bone will not hold good in regard to the Dinotherium and

many other animals. The true character of this genus, for example, so anomalous was its structure, could not be made out until after many bones had been discovered.

" These obscure surmises were ultimately cleared away by the labors of Professor Kaup. He came to the conclusion, that the Dinotherium was a pachydermatous animal, connected on one side with the Mastodon by the form of its head, and by a great aperture for a proboscis; on the other, with the Tapir, by a peculiarity in the premolar teeth.

" In 1836, Dr. Klipstein completed the anatomy of the head by the discovery of a cranium. This magnificent fossil, the only known specimen of a cranium, has served to supply various scientific cabinets with casts of the head. The head itself lies in the cellars of the British Museum; the owner, Dr. Klipstein, not being able to obtain the price he has thought right to demand for it. It was intimated to me, by a friend of Dr. Klipstein, that I might purchase it on favorable terms.

" *Anatomy.* — The head of the Dinotherium giganteum is nearly four feet long and about a foot and a half high; the distance from the orbitar fossa to the posterior edge of the temporal fossa is a foot and a half; the depth of the temporal fossa is about a foot; the angle of the os frontis and occiput is from thirty-nine to forty degrees. The summit of the head is divided into two parts by the occipital ridge, an arrangement different from that in the Mastodon, which has the occipital ridge at the posterior termination of this summit. Behind this ridge is the occipital surface, which is not vertical, as in the Mastodon, but oblique, and presenting a large space for the attachment of muscles. At its posterior termination is the occipital condyle, which has a globular form, as in the Manatus and Dugong. In front of the occipital ridge is seen the large nasal aperture, corresponding with that of the Elephant and Mastodon, and affording strong evidence that the Dinotherium belongs to the Mammalian order Pachydermata. This surface terminates anteriorly in the rostrated beak of the upper jaw. A large part of the lateral surface of the head is occupied by the temporal fossa, containing a space for the eye and for the immense temporal muscles.

" The lower jaw is remarkable for the circular curve downwards of its two projecting tusks. When discovered, the jaw was broken across, and the anterior fragment, separated by a space of a number of feet, was supposed to have had its curve directed upwards, as in the Elephant,

Mastodon, &c., presenting an unusual and grotesque appearance. In this position they were first represented by Professor Kaup, who tells us, that, while a friend of his was handling this anterior fragment of the lower jaw containing the curved tusks, he accidentally turned it downwards, and found it corresponded exactly with the other fragment.

"Then, for the first time, it was seen that this was the true natural direction of the tusk, and that it probably served the purpose of a pick to dig up food. Dr. Buckland suggests, that it might also be employed to anchor the head to the river-shore while the animal slept. The curved tusk with the bone in which it is socketed forms a hook about three feet in length, and the degree of curvature thus formed is the fourth of a circle.

"*Teeth.* — There are two sets of teeth; — first, the primary or milk teeth, twelve in number, three on each side of each jaw; second, the permanent, twenty in number, five on each side of each jaw. The latter are divided into pre-molars and true molars; the pre-molars are the two in front, as the name indicates, making the whole number of pre-molars to be eight. The true molars are twelve in number, three on each side of each jaw, placed behind the pre-molars. These teeth resemble the Mastodon teeth in having two or three transverse ridges, but differ from them in this, that they are all square excepting the first true molar, which has three ridges and an oblong form. In the Mastodon, all the true molars possess an oblong form, particularly the last. The middle permanent tooth of the Dinotherium, however, is sometimes distinguished with difficulty from the third or fourth tooth of the M. giganteus.

"The teeth of the Dinotherium are developed vertically, as in man and most Mammalia. In this respect they differ from the Elephant family, which, on account of the great size and weight of these organs, have them developed horizontally.

"*Trunk.* — Many bones of the trunk and extremities of this animal have been discovered, but nothing like a complete skeleton. Some of these bones are said to be of great size, exceeding corresponding bones of the Mastodon and Elephant even by one fifth. The head of the Dinotherium giganteum of Klipstein is, however, scarcely equal in dimensions to that of the great Mastodon skeleton in Boston, or that of the head in my possession, called, from the river near which it was found, the Shawangunk head. The body is represented by learned authors to be eighteen feet long, which is two feet longer than our largest

Mastodon; and fourteen high, or two feet higher than the Mastodon. The animal next in size after the Mastodon, the Megatherium, known, like the two preceding, in a fossil state only, has the height of eight feet and the length of twelve, although some of its parts are enormous.

"The bones of the extremities generally are not of great size, but there are some large bones, particularly the thigh-bone in the Darmstadt collection, more than five feet long. The thigh-bone of the great Mastodon is only three and a half feet; this would make the Dinotherium bone not quite a third longer than the Mastodon, and the skeleton about a third higher.

"The Eppelsheim thigh-bone, it has been suggested, might have been that of an Elephant. Professor Kaup did not appear to be settled in the opinion that it appertained to the Dinotherium; so that we must consider this bone not to be fairly claimed by the animal in the present state of our information. Further, we must confess that we have not seen a bone of the Dinotherium, which entitles this animal to a higher estimation among gigantic quadrupeds than the Mastodon.

"The lower jaw, attached to the cast of the head, discovered by Dr. Klipstein, is indeed longer than any Mastodon jaw; but this peculiar prolongation is destined for the support of the curved tusks, and its other proportions are generally smaller than those of the Mastodon. Thus the circumference of its medial portion is in the Dinotherium twenty inches, in the Mastodon twenty-two. The breadth of the ramus in the former is five inches just below the condyloid process, while that of the latter is at the same point ten and a half inches; the height of the ramus is two inches less in the former than in the latter.

"The cranium has already been shown to be decidedly smaller than either the Shawangunk head or that of the great skeleton. There may be, and probably are, other Dinotherium bones in existence, greater than any we have had an opportunity of seeing.

"In the comparison made above, we have considered only the largest species, the Dinotherium giganteum. There are, however, other smaller species, but their number and distinctions are not well established. The D. Cuvieri, D. medium, and D. australe of Professor Owen, found in New Holland, are pretty well understood; the others are more doubtful.

"Dr. Buckland was of opinion that this animal was aquatic in its habitation and modes of living; that it slept in the rivers, anchored by

its hook-like trunk to a tree on the river-bank. If, as the hook-like tusks would seem to indicate, it lived partly upon roots which were torn up by these instruments, we must allow it the privilege of passing a part of the time on shore. In short, we should be much disposed to consider the animal as very analogous in habit and residence to the Hippopotamus.

"While the bones of the Dinotherium are widely scattered through the continent of Europe, and even in Australia, the most remarkable deposit is found in the sands of Eppelsheim. This celebrated locality forms a part of the Rhine basin, belonging to the upper tertiary or pliocene formation. It is constituted by layers of loess, of calcareous and ossiferous conglomerate, of sand, of clayey marl, and, finally, of fragmentary ossiferous and marine conglomerate, arranged in layers from one to several feet in thickness. In the last of these are found the remains of the Dinotherium. The whole depth from the surface is about forty feet. They lie in great confusion, intermixed with the bones of other animals, among which we find those of Mastodon longirostris, Rhinoceros Schleiermacheri, Acerotherium incisivum, Arctomys primigenia, Spermophilus superciliosus, Tapirus priscus, Sus palæologicus, cervus, &c. Of these and other bones from the same place we have fine casts, made under the direction of Professor Kaup.

"How these vast collections were formed in the London, Paris, Rhine, and other basins, is a matter of deep interest. The more common opinion has been, that this conglomeration was formed by some great deluge. In many cases, however, the bones lie in their natural position, as if the animal had died quietly on the spot, and their remains were gradually accumulated during a course of countless ages.

"How should so many species and families have been exterminated? The march of geology and paleontology will no doubt lead us to wonderful discoveries in these new sciences, and thus afford some answer to this question; but probably there will always remain many inexplicable phenomena to keep alive the curiosity of future generations."

Professor Peirce communicated the results of his investigations relating to Foucault's experiment with the pendulum. In the course of his remarks, he referred to a mathematical discovery by Encke, which had been anticipated by Mr. G.

P. Bond, and to Airy's plate apparatus, which was similar in principle to such as had been previously contrived and used by Mr. Treadwell and by Mr. Boyden.

Dr. Peirson referred to an explosion of "burning-fluid," which caused the death of Miss Mary F. Choate of Salem, on the twenty-fourth day of last February; and read an article communicated to the Salem Gazette by Dr. E. L. Peirson, which contained a very particular account of the circumstances connected with the explosion, as investigated by that gentleman and himself. The disaster occurred in an unfinished pantry, about ten feet long and nine feet wide; in one corner of which, on a shelf at the end of a sink, and on a level with the top of it, which was three feet above the floor, there stood a can of the capacity of one gallon, partly filled with "burning-fluid." The can was screened in a great measure from the direct heat of the stove by two water-buckets, which stood on the same shelf. The mouth of the can was stopped with a plug of white-pine, and the nozzle with a small rag. A few seconds before the explosion, the girl was seen pouring water from the tea-kettle upon some meal with her right hand, and stirring the meal with her left; and was, without doubt, thus employed, when a very loud explosion occurred, and enveloped her and various other objects in the room in flames. The bottom of the can was blown out and thrown to one part of the room, and the body of it, with the plug still in the mouth, to another. The mother did not recollect what became of the nozzle. The girl survived the accident about twelve hours. Dr. Peirson invited an expression of opinion respecting the cause of the explosion.

Professor Horsford stated that he had visited the scene of the explosion. After illustrating with a diagram the position of the various articles of furniture in the apartment where the accident occurred, he remarked, "that the Salem case presented several difficulties, among the most important of which he enumerated the following: —

"1. How fire could have been communicated to the mixed

vapor and atmospheric air in the can, at a distance of six feet from the stove, the only source of fire in the room.

"2. How an explosion could occur by which burning-fluid should be thrown on the outside and corresponding inside of the water-pail nearest the can, and not on the shelf or the boards in the corner.

"3. How this could take place (if produced by the explosion) with no opening on the side of the can nearest the water-pail.

"4. How, fire having been communicated to the contents of the can in its proper place, explosion should not have thrown at least the empty pail from the shelf.

"5. And how, since the pails were neither of them moved by the shock, an explosion could cause the can to leap over the pails and fall, not back into its place, but upon the floor, some four or five feet distant.

"These are among the apparently contradictory phenomena which any attempt at an explanation must reconcile.

"The communication of fire has seemed to be the principal difficulty in the case. It has been suggested that the rag stopper, saturated with the burning fluid, might have taken fire, as cotton-waste (cotton more or less saturated with oil) has been known to take fire. This explanation cannot be sound. Burning-fluid vaporizes at a low temperature. In vaporizing it absorbs heat. The purer varieties absorb so much heat, that a low wick is but slightly charred after an evening's burning. It is quite obvious, therefore, that heat enough to inflame a body so volatile could not be derived from the spontaneous oxidation of the body itself. Nevertheless, I made several experiments upon the fluid, thinking that exposure might, by oxidation, produce so much resin in the burning-fluid, and the rapidity of volatilization be thereby so much reduced, that the conditions of the rag stopper and waste cotton would more nearly approximate, and spontaneous ignition occur. The result, however, has been a negative one. It could not have been otherwise. With the reduced volatility came diminished oxidation, so that what was gained by the process in one way was lost in another.

"The impression that the wooden stopper fitted closely, has barred an attempt at the natural explanation. This impression was based upon two circumstances; — first, that in the explosion the plug and neck were not separated; and second, that no smell of burning-fluid was ever noticed in the room. In regard to the first, it is easy to see that a four-sided stopper might be driven into a cylindrical neck so tightly, as to be extracted only with great effort; and in regard to the second, very considerable quantities of burning-fluid vapor may be in a room without its being observed, as I have ascertained by placing small quantities in a number of vessels permitting ready evaporation, and by sprinkling it on the floor. The space between the pine plug and the neck I have found to be of at least twice the diameter required to transmit flame. It will be recollected that the fire was of shavings and pine-wood, and that the mother observed, a minute or two before the explosion, that it burned well, and that a portion of the stove was red-hot. Upon inquiry, she told me that the pine-wood used would snap. It is conceivable, that, when the daughter inclined the tea-kettle, as she did just before the explosion, a bit of coal was thrown through the open passage to the neck of the can; that the increasing warmth of the apartment had driven a little of the mixed vapor and atmospheric air through the space between the plug and neck to the air above, increasing somewhat the area of the target against which the shaft was aimed; and that this explosive mixture was fired and ran back into the can.

"The expansion attendant upon the explosion would press outwards in all directions the walls of the can. If all could not yield alike, the least firm would obey the impulse. The conical top is not constructed to yield without rupture to pressure from within. The vertical sides are alike unable to give increased space without rupture. The neck and plug, offering less resistance, would be blown off. The bottom, being a plane, can be pressed downwards, so as to form an obtuse cone. As the shelf, however, is firm, the depression of the

centre of the bottom must be attended with the elevation of the whole body of the can, and the sudden downward movement of the bottom would cause the can to spring into the air. The shelf was inclined toward the sink, and the outer half inclined also a little outward. This inclination would give the upward movement of the can a direction from the perpendicular, and, if the can were seated on the outer half, an inclination outward from the shelf and sink. The latter supposition is a little more favorable to the view taken, but not essential. With a velocity that would carry the can to the inclined roof, it is easy to see how the nose could have been broken (the neck and plug having been separated by the explosion), and, with the momentum acquired, how a quantity of fluid would rush out upon the rafter or inside of the roof, and some of it fall. The can, as the resultant of the collision of its irregular form with the inclined inner surface of the roof, would acquire more or less of a whirling motion, and, scattering fluid in its way, would ultimately reach the floor. A jet of it falling upon the stove would instantly enshroud it and the girl by its side in flames. The heat of the burning fluid about the can would melt the solder, release the bottom, and such portions of the soldered seams as were not protected by the fluid. The line of attachment of the conical top to the sides, the opened seam of the top itself, the undisturbed ear, to which the pail was on one side secured, and the gathering of the molten solder in the same region, all are in keeping with the idea, that the can lay partially immersed, and so far protected, by the fluid on the floor. To return to the point of collision of the can with the roof. What point on the shelf would a small quantity of fluid reach, thrown from the neck of the can at the instant of its collision with the roof, and falling perpendicularly? A point manifestly lower on the inclined shelf than that occupied by the can; and although it may not now be susceptible of absolute demonstration by admeasurement, since the exact position of the article is not known, it is obvious, upon an inspection of the premises, that

the point a liquid would reach, falling from the intersection of a line drawn from the can's place perpendicular to the shelf with the roof, must have been very near the edge of the pail. Indeed, it is difficult, if not impossible, to see how just liquid enough to have fired the outside and inside of one of the pails, and not the shelf or surrounding surfaces, could have come from any other point than one above.

"This view leaves no statement of the surviving inmates, or fact of the appearances as presented after the accident, without a legitimate explanation. It is, perhaps, difficult to believe that a coal would have sprung from the stove, through a space of six feet, with such precision as to inflame the fluid about the nose of the can. But six feet is not an unusual flight for a fragment of coal from snapping wood. Nothing intervened to obstruct its course. The kettle was tipped so as to give it a ready passage, and even presented a reflecting surface that would aid in sending some indirect sparks in the required direction. The bit of coal would be glowing from its friction with the air, and in the precise condition to insure explosion on its arrival at the neck. It is, therefore, no more wonderful that the spark should take the precise direction it did, than that the can should have been placed in its pathway.

"In conclusion, then, it may be stated in regard to the Salem case, —

"1. That the evidence does not require us to believe in the spontaneous explosion of burning-fluid; or

"2. That the explosion was any thing else than one of a mixture of burning-fluid vapor and atmospheric air, by bringing in contact with it an incandescent body."

Professor Peirce referred to Faraday's investigations respecting the ignition and subsequent explosion of explosive gases, induced by their adhesion to clean plates of platinum and other metals, and inquired whether the explosion at Salem might not have originated from the same cause.

Professor Horsford thought that the surface of the can could not have been sufficiently clean to produce that effect.

Dr. W. F. Channing had formerly experimented with camphene and other chemical burning-fluids, and he was satisfied that they do not spontaneously explode, and that they do not form an explosive mixture with atmospheric air, without the odor of the fluid becoming perceptible to the sense of smell.

Dr. J. Bigelow remarked, "that the condition of a canister having one of its apertures stopped with a porous body, was like that of a common camphene lamp with a tube and wick. An explosion would not be likely to be communicated through the porous body, nor would it take place unless some open aperture communicated with an explosive mixture within. He mentioned a remarkable case, which occurred some years ago, in the chemical laboratory of the old Medical College. The iron pipe of a stove, containing a fire, passed within a foot of a shelf on which were deposited some bottles containing different volatile oils. In the night the whole took fire, and in the morning the shelves and side of the apartment were found deeply charred, and the room filled with smoke. The fire, however, was spontaneously extinguished. On examination, it was found that a lead pipe, communicating with a water-cistern above, had been melted off, and the water had flowed down upon the fire. The bottles which contained the oil were found in their places, some broken, others with their stoppers blown out, with appearances indicating combustion rather than violent explosion."

Dr. C. T. Jackson said "he had listened to the ingenious explanation of Professor Horsford, and would take occasion to remark, that he could not conceive how a spark from pine-bark tan could set fire to the vapor of burning-fluid, even allowing the spark should have passed near the slightly stoppered can. It is well known that a red-hot coal will not kindle a flame in camphene or burning-fluid vapor, and that actual flame or incandescent heat is required to inflame vapors of volatile hydro-carbonaceous fluids.

"If there was no other way to account for the combustion of the vapor from this burning-fluid, he would suggest that a

train of the vapor might have extended from the can to the stove, and have been inflamed by the fire, into which the vapor might possibly have been drawn. Dr. Jackson stated that he knew of several instances of the inflammation of ether, by flame distant from six to eight feet from the vessel containing the fluid, a train of explosive vapor, heavier than air, having formed a stratum from one end of the table to the other, and a flash having been seen to run from the lamp to the bottle of ether which was set on fire. This accident had happened in the laboratories of Dr. Hare of Philadelphia, of Mr. Hallowell of Alexandria, and in his own. Dr. Jackson did not think, however, that we knew the facts relating to the explosion of burning-fluid described by Dr. Peirson and Professor Horsford with sufficient accuracy to decide as to the true cause of the explosion in question."

Chief Justice Shaw made the following remarks on the subject: —

"I am very glad, Mr. President, to find that scientific and practical men are turning their attention to a subject which, in some of its aspects, seems to me a very important one. I was not aware that any such subject would be before the Academy this evening; but as it has been brought to your notice, if not too late, I should be glad to ask the attention of gentlemen to some of the views in which, it appears to me, it ought to be regarded.

"I do not profess to know any thing of the material character or chemical properties of this substance, nor can I pretend to say any thing respecting its mode of action, in forming gas, producing light, or causing explosion. But I feel that I am in the presence of those who are capable of applying all the science and skill necessary to a full understanding of this part of the subject, and it is to show the importance and value of these thorough and persevering investigations, that I am desirous of submitting these remarks.

"We often see an account published, headed, in attractive capitals, 'Another Accident from Burning-Fluid,' and often stating a case of gross carelessness, or perhaps of pure accident, concluding with an exclamation of surprise that people will wilfully continue to use so dangerous an article.

"This may be a very wise, or it may be a hasty and false conclusion. Gunpowder is a most dangerous article, and in the hands of the ignorant or imprudent, unacquainted with its properties and the precautions necessary to its safe keeping and use, may cause the destruction of human life; and sometimes, from unforeseen causes, not attributable to carelessness, it may unexpectedly ignite and cause great damage. Is this a reason why we should come to a hasty conclusion, that gunpowder ought never to be made and never to be used, notwithstanding its vast utility in the arts of war and peace, — supplying the most efficient arms in time of war, and acting as an indispensable agent in all the processes of quarrying and mining? No. But it is a reason why all the causes of danger should be investigated, ascertained, and made known, and why every precaution should be taken to guard against these causes.

"It is often suggested, I am aware, that, in using burning-fluid in preference to oil, the only object is to save a little expense in the cost, and this is an object too trifling and unimportant to warrant the running of any risk. This, it strikes me, is a very narrow and superficial view of the subject. It has been stated here this evening, that the light from camphene is whiter and purer, and the use of it more cleanly than that of oil, and the cost somewhat less. In answer to the latter fact, however, it is suggested that spermaceti oil has been much higher for a few years past than formerly, in consequence of its extensive use in manufactures. This may be the cause of a temporary rise in the price of an article, when the demand has increased faster than the supply; and that may be especially true in regard to an article like sperm oil, when so long a time elapses between the outfit and return, and when, of course, the increase of the supply is slow in following the increase of demand. But in general, when there are no intrinsic causes to cut off or diminish the supply, the supply will, in the long run, be adequate to the demand, and then the price will be regulated by the cost of production. But it appears to me that the cause of the increased price of sperm oil lies much deeper than this. It arises from the increased length and precariousness of sperm whale voyages. I understand that voyages are greatly increased in length, and in still greater proportion in expense, from the necessity of getting supplies and repairs abroad; and the chance of falling in with the sperm whale is much rarer and more precarious; so that vessels, after a long voyage, come home either not full, or filled with whale oil of inferior

quality. The actual cost of importation, therefore, being increased, the price at which it can be sold, must increase proportionally. If this be correct, whilst the use of artificial light is necessarily increasing rapidly, the resources from sperm oil are diminishing and likely to diminish still more, and the time must soon come when some other source must be resorted to, to meet this extensive and increasing want.

" But it seems to me that this is not the most important aspect of the question. There is another, affecting the labor, the industry, all the great interests of the country, more especially the great interest of agriculture, in which it deserves to be considered. Agriculture, which employs the great proportion of the entire labor of the country, which is essential to every other industrial pursuit, and forms therefore the basis of the wealth of the country, demands all the encouragement and support which the country can give it.

" Without knowing any thing in detail of the composition and chemical qualities of burning-fluid, I take it for granted, — I think it has been stated here this evening, — that by far the most considerable and costly ingredient in it is alcohol or distilled spirit. Other substances may be combined with it, to fit it for its purpose of giving a brilliant light, and perhaps to check or prevent its explosive tendency, and thus guard it from danger ; of this chemists and scientific men will inform us. But distilled spirit is the substance of it.

" If this is to be the principal, or even a very considerable, source of the artificial light of the country, it is hardly necessary to remark upon the immense quantity of alcohol which will be required. In a northern climate like ours, with a long night a part of the year, the quantity of artificial light required for manufactories, shops, stores, public buildings, and especially for domestic use, must be very large.

" Alcohol, distilled spirit, is produced from many species of grain, — wheat, rye, oats, barley, and Indian corn. We should then produce our own material for light from our own fields, — create a home demand and a home market for the products of our own farms. It is easy to perceive what an active spring this must give, what a firm and steady support it must afford, to the agriculture of the country.

" But perhaps I may be told, that, in proportion as you use grain for distillation, you diminish the quantity appropriated for the food of the people, and render bread scarce. If it were so, it would certainly be a grave, if not a decisive, objection to this use of grain. The con-constant, full, and steady supply of grain to a country, at moderate,

steady, and uniform prices, is its most important interest in an industrial point of view.

"But if I am right in my views, the argument leads to a directly contrary conclusion; and I think it is demonstrable, that the appropriation of a considerable proportion of all the grain raised in the country to distillation, will tend to make the supply of bread more constant, regular, and uniformly cheap.

"Ours is essentially an agricultural country. There are not only very large tracts of land still unoccupied; but the lands settled upon are not cultivated to a half, probably not a quarter, of their capacity to produce grain. This is a case, therefore, where, the source of the supply being unlimited, and the supply being able so soon to follow the demand, however large that demand may be, at remunerating prices, that supply will be met.

"To illustrate this, taking numbers merely to designate proportions, and not absolute quantities: Supposing the ordinary demand for the purposes of food is 1,000,000 bushels of grain, and a fair remunerating price for labor and the use of land is 60 cents a bushel, then $ 600,000 would be paid the farmer for the crop. Then, supposing that by a change of habit, by which light is to be supplied from alcohol, and alcohol from grain, a demand has been established for 500,000 bushels more, and the burning-fluid distiller can afford to pay the same remunerating price, as the case supposes, then there will be a regular and steady demand in ordinary years for 1,500,000 bushels, and the farmer is paid $ 900,000 instead of $ 600,000 for his annual crop. The $ 300,000 a year goes steadily and regularly to the payment for labor, home labor, and the use of land.

"This supply of grain for light, not occasional or precarious, not depending upon foreign commerce, the policy of other countries, or the contingencies of war and peace, and not depending on fancy or fashion, but being a constant, ever-recurring, and ever-increasing want for an absolute necessary of life, for which all who need it must pay a remunerating price, according to the cost of production, the demand would be as constant and steady for distillation as for consumption in bread. Indeed, the grain-market would know no difference.

"It is obviously for the interest of a country to produce annually a quantity of grain considerably beyond the average demand for consumption as food. It tends to maintain and equalize prices, and to prevent the bad effects both of short crops and superabundant harvests.

An average quantity planted does not necessarily yield an average supply. Experience shows, that although an average quantity is sown, yet from the effect of drought in seed-time, of rains in harvest, and the grubs, and worms, and Hessian flies, the crop will fall below the average ; whereas, with favoring sunshine and showers, in other years, the product will be beyond the average. If the demand is for food only, so that an average crop is necessary to supply the average demand, in case of a short supply, the people will feel the ill effects in scarcity and high prices ; and in case of an abundant harvest, the supply exceeding the demand, the farmer feels the ill effects in reduced prices. And if grain does not, on an average, yield a remunerating price, the tendency is to discourage production and cause scarcity. But where there is a steady demand for a supply beyond what is necessary for food, and a quantity is produced in average years to meet that supply, even in case of short crops, there is corn enough in the country to supply the country with food, the shortness of the crop will be felt in the increased price, it will be used more economically, both for food and for distillation, and no desolating scarcity will be perceived. So, in a year of production considerably beyond the average of years, the effect will be felt in some reduction of price, affecting the whole product ; the distiller of burning-fluid, finding the price low, knowing that there will be a demand for his alcohol, which may be perfectly preserved without loss, except the slight one of interest, is induced to come into the market and purchase freely, thus maintaining and equalizing prices, to the benefit both of farmer and consumer, and causing the superabundant product of one year to supply the deficiencies of another.

" In looking at the magnitude of this interest to the whole country, and for future time, in an industrial and economical point of view, I am unwilling to give up the hope of deriving the artificial light of the country from this source, until the resources of science and skill have been exhausted in vain in finding means to keep and use it with safety. If, with all reasonable precautions, it cannot be used without danger to life, in the name of humanity let it be abandoned. But all useful agents are attended with some danger. A common lamp or candle may set fire to a dress or a curtain and destroy a life or a dwelling. All that can be hoped is to produce an article which, with reasonable care and prudence, and knowledge of its qualities, may be used with reasonable safety.

"It appears to me, that there are two modes in which scientific research and investigation may tend to prevent or lessen the danger in using this article. One is, by a thorough knowledge of the chemical qualities of these ingredients, so to mix and combine them, as to render them less explosive; and the other to ascertain and point out the mode of action and operation of these fluids, and show the causes and modes of sudden and unexpected ignition, so that those who use them may easily learn, and with ordinary prudence practise, the necessary means of avoiding danger. In the hope that something of this sort can be done, I commend the subject to the continued attention of our scientific friends."

Dr. C. T. Jackson, in illustration of the views of Judge Shaw, observed, "that the use of alcohol was of the greatest importance to the agriculture of the Western States, for it was the most valuable product of Indian corn in many of those States. If corn could not be converted into alcohol and oil, it would in many places cease to be a profitable crop. Indian corn, when fermented, yielded first fifteen gallons of *oil of corn* (a fixed oil) per hundred bushels of corn.

"The next product was a fermented one, which on distillation yielded corn-whiskey, and the corn-whiskey passed into our Eastern States for manufacturing purposes.

"This was, in part, rectified into alcohol of ninety per cent., and that was used for the manufacture of burning-fluid, of cologne, spirits or tinctures of various kinds, &c. The ordinary whiskey was used for making white vinegar by fermentation in tuns filled with beach shavings, and this vinegar was employed in the manufacture of white-lead and sugar of lead. This vinegar was also extensively sold for making pickles and for domestic uses, and, when colored by burnt sugar, passed ordinarily for cider-vinegar, though it was not so pleasant to the taste as the true cider-vinegar.

"The oil from Indian corn has thus far been profitably separated only by the process of fermentation. It is of sufficient value to repay the cost of raising corn in the Western States, the oil being worth on the spot where made about

one dollar per gallon, which is fifteen cents' worth of oil per bushel of corn. The alcohol or whiskey was also a valuable product.

"Dr. Jackson had separated from six to eleven per cent. of pure corn oil from the eastern varieties of Zea mays, and had found most oil in the Canada and rice corn. It is contained in the gluten-cells of the grain, and is set free by decomposition of those cells by fermentation."

Three hundred and sixty-first meeting.

May 4, 1852. — MONTHLY MEETING.

The VICE-PRESIDENT, Mr. Everett, in the chair.

Professor Agassiz måde an oral communication at considerable length, "On the Foundation of Symmetry throughout the Animal Kingdom."

Dr. Asa Gray communicated the characters of two new genera of plants of the order *Violaceæ*, discovered by the naturalists of the United States Exploring Expedition.

"One of these genera, of a single species, was discovered in the Feejee Islands. It belongs to the tribe *Violeæ*, having an irregular corolla, which is not unlike that of Ionidium ; but the fruit is probably baccate, and the stamens are diadelphous, the posterior one being distinct from the four others. Something like this structure occurs in Corynostylis ; but the corolla of that genus is very different. The genus is named in memory of the botanical draughtsman of the expedition, the late Alfred T. Agate. I trust that the name Agàtea will be deemed sufficiently different from Agathèa and Agati to be retained.

"AGATEA, Nov. Gen.

"Calyx 5-phyllus, subæqualis, basi haud productus, deciduus. Petala 5, erecta, inæqualia ; postica lateralibus paullo minora ; anticum majus, labelliforme, spathulatum, basi dilatatum gibboso-saccatum. Stamina 5, diadelpha, nempe ; filamenta brevia, plana, antica (glandula carnosa aucta) et lateralia marginibus connata, posticum angustius distinctum : antheræ introrsum adnatæ, loculis appositis apice liberis mucronatis ; connectivo in appendicem petaloideam latam producto. Ovarium globosum ; placentis parietalibus 3 pluriovulatis. Stylus apice clavatus,